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INFECTION CONTROL IN AIR FORCE DENTAL CLINICS,(U)
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AEROMEDICAL REVIEW

INFECTION CONTROL IN AIR FORCE DENTAL CLINICS

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December 1980

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This review has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This aeromedical review has been reviewed and is approved for publication.

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This document prescribes responsibilities and methods of sterilizing or disinfecting dental items in Air Force dental facilities to prevent or reduce the chance of cross-infection of patients and staff. The importance of preparing dental items for sterilization is discussed, along with the shelf life of sterilized packages under optimum storage conditions. The efficacy of heat versus room-temperature sterilization is examined. Indicators of sterilization, both chemical and biological, are compared, also a cost analysis of each. Hands are a convenient transfer organ for bacteria, and proper

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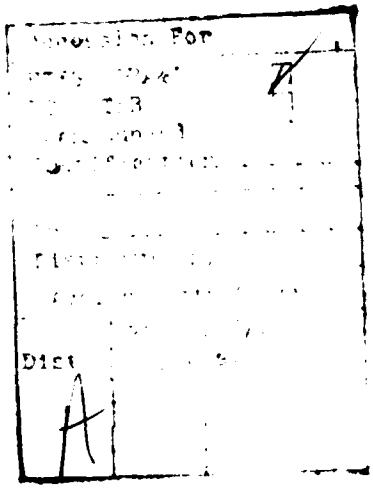
20. ABSTRACT (Continued)

washing and gloving are essential. The dental laboratory asepsis procedures reduce microorganism transfer by breaking the chain of infection at critical transfer points in the fabrication, repair, and delivery of prostheses.



CONTENTS

CONTENTS (Continued)

INFECTION CONTROL IN AIR FORCE DENTAL CLINICS

INTRODUCTION

The purpose of this Aeromedical Review is to prescribe responsibilities and methods of sterilizing or disinfecting dental items in dental facilities in order to prevent or reduce the chance of cross-contamination and infection of patients and staff.

Dental patients and members of the dental health delivery team are potential sources of microbial infection. They may be active or passive carriers for many different infectious diseases. Active carriers of hepatitis B virus (active carrier rate, 1 patient in 150); *Streptococcus pyogenes*, the agent of strep throat (active carrier rate, 1 patient in 10); and *Staphylococcus aureus* (active carrier rate, 1 patient in 5) are most important (7). Hepatitis B virus may be transmitted intracellularly in minute quantities of blood or saliva. Streptococcus and staphylococcus are found in saliva. Meticulous cleaning of instruments prior to sterilization is essential because soiled or heavily contaminated materials can overchallenge all practical methods of sterilization or disinfection. Dental instruments must be sterilized whenever possible. Sterilized instrument packages should receive minimal handling before they are used.

Infection control procedures, as described in this document, should be submitted to the hospital/clinic infection control committee for review and verification. Approved procedures must be followed at all times. Infection from dental procedures is largely preventable if sound principles of sterilization and disinfection are followed.

Definitions

Sterilization--The process by which all forms of life within an environment are totally destroyed. Steam or chemical vapor applied under specific conditions of time, temperature, and pressure provide the easiest and quickest sterilization. Sterilization should be monitored and verified routinely.

Disinfection--The destruction or inhibition of most pathogenic bacteria while they are in their active growth phase and the inactivation of some viruses. For disinfection, chemicals are applied. Spores are not destroyed. Tubercle bacilli and some viruses may survive, depending on the chemical used. Disinfection is not easily monitored, controlled, or verified, and the potential for infection remains.

Classification of Dental Items

Critical Disposable Items--These items are introduced beneath the skin and present the greatest potential risk of infection (example: scalpel blade, injection needle). Critical disposable items require sterility.

Critical Nondisposable Items--These items make direct contact with mucous membranes (example: mouth mirror, dental handpiece). Critical nondisposable items should be sterilized. Disinfection is acceptable only if sterilization is neither possible nor practical.

Noncritical Items--These items do not come in direct contact with the patient (example: lamp handle, cabinet top). Noncritical items need periodic disinfection. Items that may be touched by hands during patient treatment require more careful attention than others and should be thoroughly disinfected after each patient is treated.

Responsibilities

Base dental surgeons should appoint a dental officer as the infection control coordinator to assist in meeting the following requirements:

(1) Insure that protective eyewear is worn by dental personnel and is available for patients when treatment may result in the formation of an aerosol or spatter.

(2) Insure the use of face masks during surgical procedures. Encourage the use of masks during routine dental care.

(3) Encourage patients to rinse with a suitable mouthwash, for short-term reduction of oral microflora, before dental procedures are initiated.

(4) Promote compliance with the recommendations set forth in the following areas of this review:

- Sterile Items and Handling Procedures
- Heat Sterilization
- S erilization Indicators
- Room-Temperature Chemical Sterilization/Disinfection
- Sterilization or Disinfection of Dental Treatment Room Equipment
- Handwashing and Gloving
- Dental Laboratory Asepsis
- Dental Item Sterilization/Disinfection Guideline

Users are invited to send comments, suggested improvements, or inquiries concerning this guideline to the Chief of Clinical Dentistry, USAFSAM/NGD, Brooks AFB TX 78235.

STERILE ITEMS AND HANDLING PROCEDURES

Sterile Packages

The advantages of sterile packages include sterility of the contents up to the time the package expires or is opened, easy removal of the contents without contamination, and convenience of having items readily available. Commercially sterilized items are usually expendable. In-house sterilized setup packs may contain disposable and nondisposable items. Commercially sterilized expendable items, such as needles and heat-stable suture material, may be placed in in-house packs before pack sterilization.

Using Sterile Items

Handling--The following procedures will minimize cross-infection:

(1) Use only sterilized syringes and commercially presterilized disposable needles for injections. Safely dispose of used needles after each appointment.

(a) If a member of the health delivery team is injured by a needle or any instrument contaminated with blood by a *known* hepatitis B carrier, take the team member to the Emergency Room where an AF Form 570, Notification of Patient's Medical Status, will be completed. If antibody status for hepatitis B virus is negative or unknown, blood will be taken for appropriate studies and, if necessary, immunoglobulin will be administered.

(b) If a member of the health delivery team is injured by a needle or any other instrument contaminated with blood by a patient who is only *suspected* of having hepatitis B virus, send both the team member and the patient to the Emergency Room for evaluation of the patient's carrier status and the team member's antibody titers. Immunoglobulin will be administered when necessary.

(2) Use individual-dose anesthetic carpules for routine dental procedures, and discard carpules even though only partially used.

(3) Use commercially sterilized disposable scalpel blades, suture materials, and rubber gloves for surgical procedures.

(4) Use disposable saliva ejector/aspirator tips, mouth props, and other such items when possible, to minimize cross-infection and reduce the sterilization workload.

(5) Discard disposable needles, suture needles, and scalpel blades into the same receptacle. Empty these receptacles and dispose of the contaminated items according to local procedures.

Disposal of Septic Materials--

(1) Double bag disposable items, label them "contaminated trash," and place them with the regular trash to be disposed of in a sanitary landfill or by other means as determined by the pickup service.

(2) Place nondisposable linen items such as towels, drapes, and sheets in a biodegradable bag and place that bag into a regular plastic bag. Label the bundle "contaminated" for pickup with the regular linen. This procedure allows the laundry personnel to avoid contact with the infectious agent by placing the biodegradable bag with its contents directly into the washing machine.

(3) Place nondisposable dental items in a sterilizer and process them through a cycle, then clean the items and prepare them for final sterilization.

Preparing Items for Sterilization

Cleaning--

(1) Soon after their use, thoroughly scrub all instruments with a brush under running water in the dental treatment room (DTR) or central sterilization area. To prevent hand puncture wounds, provide heavy utility rubber gloves for all personnel engaged in scrubbing procedures. Remove all foreign material from the object to be sterilized so that sterilizing agents can make direct contact with all surfaces.

(2) Use ultrasonic cleaning units when available to remove foreign material from areas that are inaccessible or difficult to clean. Ultrasonic units reduce injury to hands from accidental puncture by instruments during the scrubbing procedure. Suspend items placed in an ultrasonic unit above the floor of the unit for maximum cleaning efficiency. Fill stainless-steel tank 1/2 to 3/4 full with ultrasonic general purpose cleaner or disinfectant solution. If an auxiliary pan or beaker is used instead of a basket, fill this container to a level slightly above the item to be cleaned. This container, when placed just below the solution level in the main tank, will function as an ultrasonic cleaner. Change solution daily or weekly, as needed. Keep a cover on the main tank, auxiliary pan, and beaker. Rinse instruments under running water before and after ultrasonic cleaning.

Inspecting--Inspect all items after they have been cleaned and dried, test them for function, and sort.

(1) Inspect all metal items for signs of rust, cracks, chips, and bent or missing pieces.

(2) Check jointed instruments for free movement, full closure, and locking of ratchets.

(3) Check instruments for sharpness and proper closure.

(4) Inspect linens for tears, holes, stains, or other defects.

(5) Follow local policy regarding lubrication, sharpening, repairing, replacement, or disposal of items no longer considered serviceable.

Packaging--

(1) Package dental items either individually, in sets, or in packs, depending upon intended use. If requested, arrange items contained in packs in the sequence in which they are normally used. The most common packaging materials are paper, plastic, nylon, or cloth. Wrap packages loosely to allow the sterilizing agent to circulate freely throughout the pack. Insure that scissors, hemostats, and other hinged instruments are in the open position. The size of the individual pack will generally determine the best wrapper material. When the sterilization cycle is complete, label the packages with a shelf-life expiration date. This date should correspond to shelf life as listed in Table 1. Store sterilized items in a clean area and handle as little as possible. Packs should be opened with an aseptic technique.

(2) When plastic or nylon sterilization tubing is used to bag instruments, the pack, after sealing, should be 20% longer than the longest instrument. The extra length allows inside air to expand and insures that a single heat or tape sealing will hold (16). Instruments are also packaged in paper envelopes. When tape is used for sealing, its length should be 2 1/2 times longer than the width of the tubing or paper envelope. This allows the tape to be sealed upon itself after the tube or paper envelope is folded.

(3) When cloth is used as the packaging material, use a double thickness.

Storage and Shelf Life

(1) See Table 1 for shelf life of sterilized items under optimum storage conditions.

(2) Inspect sterile packs visually prior to use. Rewrap and sterilize packs suspected of being contaminated or stored beyond their expiration date (19).

(3) Observe manufacturer's directions when handling and storing commercially presterilized items.

TABLE 1. EXPECTED SHELF LIFE OF INSTRUMENTS WRAPPED IN DIFFERENT MATERIALS (19)

Wrapper	Shelf Life
Paper envelope (tape sealed)	30 days
Cloth wrap (double thickness)	30 days
Nylon, plastic, or plastic-paper combination pouches (tape seal)	4 months
Nylon, plastic, or plastic-paper combination pouches (heat seal)	6 months

HEAT STERILIZATION

General

Heat is the most practical and dependable method of achieving sterility (see Table 2) and should be used in preference to room-temperature chemical means. Proper cleaning methods must be used before thermal sterilization.

Sterilizing Methods

Keep the directions supplied by the manufacturer of the sterilizer in the vicinity of the unit and follow them closely.

Steam under Pressure (Autoclave)--Autoclaving is an acceptable method of sterilization unless cutting edges are of carbon steel.

Chemical Vapor under Pressure--This is the preferred method of sterilization because of the shorter time required. It is less corrosive, does not dull sharpened edges, and therefore increases the life expectancy of dental instruments. Observe the following precautions (15):

(1) Use only Vapo-Steril solution. Empty condensate tank before refilling reservoir. Do not reuse condensate.

(2) Do not permit open flames, smoking materials, electrical or mechanical items that may spark or arc, or any other ignition source within 2 feet of the chemiclave.

(3) Be careful when opening the door at the end of the cycle. Open the door at arm's length and stand back for 10 seconds before approaching the sterilizer.

(4) Place sterilizer under hooded vent whenever possible if chemipurge attachment is not available with the sterilizer.

(5) When sterilizer is not in use, leave the door closed but unlatched. This will increase the life of the rubber door gasket.

Dry Heat--Zinc oxide and other powders are not rapidly penetrated by steam or chemical vapor sterilizers. Sterilize these materials by long exposure to dry heat.

Heat Transfer--A sterilizer containing glass beads or common table salt may be used at chairside to quickly sterilize small instruments. This method is used mainly during endodontic treatment to quickly sterilize individual files, reamers, and other small instruments previously sterilized.

TABLE 2. COMPARISON OF VARIOUS MODES OF HEAT STERILIZATION

Methods	Temperature	Time[a]	Pressure	Disadvantages
Autoclave (12)	121°C (250°F) 132°C (270°F)	30 min 7 min	15 psi 30 psi	Rusts, corrodes instruments
Chemical vapor (12)	132°C (270°F)	20 min	20 psi	Slower penetration of chemical vapor than steam
Dry heat (12)	160°C (320°F)	1 hr	None	Increased time factor
Heat transfer (1)	232°C (450°F)	15 sec	None	Limited to small instruments

[a]Time after appropriate temperature and pressure is reached.

STERILIZATION INDICATORS

Routine testing is necessary to insure that instruments have been exposed to proper heat, time, and pressure for sterilization. Sterility is assured if a biological spore monitor, placed with the instruments inside the packaging material, is negative for growth. Instead of placing a monitor inside each package, place a monitor in one package centrally located in the sterilizer load. Various spores are used to challenge the sterilizers. *Bacillus stearothermophilus* spores are more resistant to autoclave and chemical vapor, and incubate at 55°C. *B. subtilis* spores are more resistant to dry heat and ethylene oxide, and incubate at 37°C. See Table 3.

TABLE 3. SPORES USED AS STERILIZATION INDICATORS (14)

	Autoclave	Chemical vapor	Dry heat	Ethylene oxide
B. stearothermophilus	Yes	Yes	No	No
B. subtilis	No	No	Yes	Yes

It's essential not only to verify that the sterilizer is working properly but also to insure that instruments are exposed to the sterilizing cycle. For this, use processing indicators (example: autoclave indicator tape, indicator bag, stick-on label).

Sterilizer Verification

Testing using biological spore monitors should be done weekly, as requested by the Joint Commission on Accreditation of Hospitals (11) and the American Dental Association (8), unless Air Force policy dictates otherwise.

Table 4 shows the compatibility of biological spore monitors with sterilizers, and Table 5 gives acquisition data.

TABLE 4. COMPATIBILITY OF BIOLOGICAL SPORE MONITORS WITH STERILIZERS

	Chemical vapor	Autoclave	Dry heat	Results interpreted
Polypropylene vial	Yes	Yes	No	Dental clinic
Glassine enclosed	Yes	Yes	Yes	Micro lab
Ampule	No	Yes	No	Dental clinic or micro lab

TABLE 5. BIOLOGICAL SPORE MONITORS

Enclosed in	Brand name	Address	Cost[a]
Polypropylene vial	Attest 1242	Medical Products 3M Center St. Paul MN 55104	$104.60/100[b] GS-00S-86614 ($1.05 ea)
Glassine envelope	Steri-Spor Spore-O-Chex Spordi UniSpore	Federal Stock # 6530-00-4776720	$17.12/package of 12 ($1.43 ea)
Ampule	Kilit	BBL Microbiology WATS 800-638-8663	$45.90/100 (46¢ ea)
	Chemspor	AMSCO WATS 800-458-0598	$85.00/100[c] (85¢ ea)

[a]Prices current as of 1 Sep 80
[b]Incubator cost $45.08
[c]Incubator cost $95.00

Polypropylene Vial (Example: Attest 1242)--Used in chemical vapor or autoclave sterilizers (6). The spore tested is *B. stearothermophilus*. The vial has filter paper on the lid to allow chemical vapor and steam to penetrate to the spore strip which is in the bottom of the vial. The culture medium is contained in a glass ampule within the vial. After placing the vial in the center of a pack to be sterilized and cycling the sterilizer, crush the glass ampule and incubate the vial according to instructions. At the end of 48 hours, record the final reading. The test for bacterial growth is positive if the color changes from purple to yellow. Microbiology laboratory assistance is not required. (Use Attest 1244 in ethylene oxide sterilizers only.)

Glassine Envelope--Spores tested are primarily *B. stearothermophilus* and *B. subtilis* (4). Place glassine envelope with enclosed spore strip through normal sterilizing cycle. Deliver intact envelope to medical laboratory, and specify on this envelope which type of sterilizer was used and the bacillus species to be incubated. Spore strips are aseptically removed from the glassine envelope and incubated for 7 days. Results are returned to the dental clinic.

Ampule (Example: Kilit, Chemspor)--Spore tested is *B. stearothermophilus* (3, 5). Ampules contain spores suspended in culture media. After placing the ampule in the center of a pack and cycling it in a sterilizer, deliver the ampule to the laboratory or incubate at 55°C in the dental clinic. The Chemspor ampules have the advantage of a process indicator floating in the broth to indicate that the monitor has been through a sterilizer cycle. Ampules are water or air incubated, unopened, for 7 days. The test for bacterial growth is positive if their original color changes to yellow.

Process Indicator

A process indicator is a visual monitor that verifies when an item has been through a sterilizer cycle. The three main types of process indicators are autoclave indicator tape, indicator bag, and stick-on label. All dental items or packaged instruments should have a process indicator attached. Table 6 summarizes the types of and uses for process indicators and biological monitors.

TABLE 6. SELECTION OF PROCESSING INDICATORS AND STERILIZATION MONITORS

	Processing indicator	Biological monitor
Purpose	Gives assurance that each item or package has been processed	Gives assurance that sterilizing conditions used are effective against highly resistant bacterial forms
Types	Autoclave indicator tape, indicator bags, stick-on labels	Spore strips in polypropylene vials and glassine envelopes; spores in ampules
Limitations	Not accurate indicators of time, temperature, and pressure conditions required for sterilization	Results are not immediately available and their accuracy depends on proper placement
Frequency of use	Each item or package	At least once a week in each sterilizer (unless Air Force policy dictates otherwise)

Chemical Monitor

Slow-color-change chemical monitors are available for autoclave and dry-heat sterilizers. These monitors are not a substitute for a biological spore testing, although they consist of strips of paper that darken in approximately the same time required to kill spores. One strip can be placed in each pack and observed immediately upon opening the pack. If hospitals require chemical monitoring, a piece of autoclave indicator tape can be folded upon itself and placed inside a pack in an autoclave (13). Chemical monitors are usually stored for a specific time period mandated by hospital regulations.

ROOM-TEMPERATURE CHEMICAL STERILIZATION/DISINFECTION

Room-temperature chemical disinfectants used on dental items do not penetrate organic matter retained on instruments and equipment. This residual organic material may contain resistant pathogenic bacteria, viruses, and fungi; therefore, thorough cleaning procedures are necessary before room-temperature chemical sterilization/disinfection.

Sterilizing Methods

Use room-temperature chemical agents to sterilize critical nondisposable items when heat sterilization methods are contraindicated or not available.

Ethylene Oxide--This is the most reliable agent available for chemical sterilization. Its primary disadvantages include slow action (4-6 hours) and prolonged aeration time (1-4 days). It may be used for such heat-labile dental items as nonautoclavable handpieces and rubber products. Use a biological spore monitor for each load of items sterilized with ethylene oxide. (Sterilizer generally not available in dental clinics.)

Glutaraldehyde--For sterilization, 2% undiluted alkaline glutaraldehyde solution reacts with the proteins of microorganisms, rendering them nonviable. This solution destroys fungi, viruses, and bacteria, including *Mycobacterium tuberculosis* and spores, when items are immersed in the solution for a specific period of time. It is recommended for adhesive-bonded instruments, rubber or plastic articles such as X-ray holders/bite blocks, and other materials not amenable to heat sterilization. Cidex 7 and Sporicidin have twice the shelf life, after activation, as Cidex (Table 7). Sterilization with liquid germicides such as glutaraldehyde cannot be tested or verified routinely. [The acidic glutaraldehydes (example: Sonacide, Wavicide 01) are not cold sterilizing solutions. For sterilization in acidic glutaraldehydes, items must be immersed in 60°C (140°F) solution for at least 1 hour.] Note the expiration date of the solution on the lid of the container in which it is stored. Table 7 indicates immersion time necessary for sterilization with the three types of alkaline glutaraldehydes and their shelf life after activation. Glutaraldehyde solutions may cause minor irritation to the eyes and skin upon contact. Use forceps or rubber gloves while thoroughly rinsing items sterilized with this agent. To prevent corrosion, carbon-steel objects should not be sterilized in glutaraldehyde solutions.

TABLE 7. ALKALINE GLUTARALDEHYDE STERILIZING SOLUTIONS (9)

	Glutaraldehyde	Glutaraldehyde, longer life	Glutaraldehyde with phenol
Example	Cidex	Cidex 7	Sporicidin
Immersion time	10 hr	10 hr	6 hr 45 min
Shelf life (after activation)	14 days	28 days	30 days

Disinfecting Methods

The following sections and Table 8 discuss substances to use for disinfection. Individuals with sensitive skin should use rubber gloves during chemical disinfection.

TABLE 8. SOLUTIONS FOR DISINFECTING ITEMS

Solution	Stock conc.	Cost[a]	Acceptable dilution	Do not use on	Wear gloves
Glutaraldehyde, alkaline (example: Cidex)	2%	$ 8.26/gal[b]	None		X
Glutaraldehyde, alkaline, longer life (example: Cidex 7)	2%	13.87/gal[c]	None		X
Glutaraldehyde, alkaline, with phenol (example: Sporicidin)	2%	20.25/qt[c]	1:15 with water		X[e]
Glutaraldehyde, acidic (example: Sonacide)	2%	12.75/gal[d]	None		X
Iodine (example: Betadine Surgical Scrub)	1%	4.38/gal[b]	1:20 with 70% isopropyl alcohol	Fabric	X
Iodine (example: Wescodyne)	1%	12.50/gal[c]	1:200 with water	Fabric	
Chlorine (hypochlorite)	5%	0.93/gal[b]	1:10 with water	Metal	X
Phenol (example: 1 Stroke Ves-Phene)	22%	12.65/gal[c]	1:250 with water	Instruments used during treatment	X
Alcohol (isopropyl)	99%	14.20/5 gal[b]	70%[f]		X
Quaternary ammonia	SHOULD	NOT	BE	USED	

[a]Prices current as of 1 Sep 80
[b]Stocklist
[c]GSA
[d]Local purchase
[e]Not necessary if diluted 1:15 with water
[f]Presence of water is necessary for bacteriocidal action

Glutaraldehyde--For disinfection of salivary-contaminated items, a 30-minute immersion in the alkaline glutaraldehydes (Cidex, Cidex 7, or Sporicidin) is advisable (21). Phenol-containing glutaraldehyde (Sporicidin) can be diluted up to 1:15 parts with water and retain its disinfection, but not sterilizing, capability. Glutaraldehydes which are acidic (example: Sonacide, Wavicide 01)

also require a 30-minute immersion for disinfection. Glutaraldehyde solutions can be used as holding solutions for instruments before preparing them for sterilization. Instruments should not be kept in any solution for prolonged periods.

Iodine--A solution containing 0.05-1% active iodine (iodophor) is effective against viruses and vegetative bacteria. Iodophor disinfectants (example: Betadine Surgical Scrub) can be enhanced by adding 50 parts 5% [illegible] alcohol to 1 or more parts of commercial preparations containing 1% active iodine, to give approximately 0.05% or higher iodine concentrations. Iodophor scrubs may be most useful for disinfecting operatory surfaces suspected of contamination with hepatitis B virus (8). This 0.05% or higher iodine concentration should be used on nonautoclavable handpieces, dental hoses, and the dental chair (except for fabric-covered areas). The slight staining which occurs may be removed weekly with water, sodium hypochlorite (laundry bleach), or alcohol. Iodophor preparations (example: Wescodyne) are disinfectants at concentrations of 1:[illegible] with water. Wescodyne can be used for routine scrubdown of all operatory surfaces, except fabric. The slight staining from Wescodyne cannot be removed with water, sodium hypochlorite, or alcohol.

Chlorine--Sodium hypochlorite solution is a disinfectant for use with critical nondisposable and noncritical nonmetal items. A 0.5-5% concentration is bacteriocidal and virucidal, and possesses some sporicidal activity at the higher concentrations. Chlorine-containing agents work well for [illegible] items but, because of their corrosiveness, should not be used for disinfecting metal instruments or metal equipment. Chlorine solutions are unstable and are readily inactivated by organic material. Replace chlorine bleach solutions, used to disinfect plastics, on a daily basis.

Phenol--Phenol-containing germicidal solutions (example: [illegible] Phene) may be used for cleaning, deodorizing, and disinfecting surfaces. Skin contact will cause depigmentation, so gloves should be worn.

Alcohol--Isopropyl alcohol, NF, is 99% pure. [illegible] bacteriocidal. It must be diluted to approximately 70% to be a bactericidal agent. At 70% concentration isopropyl alcohol is a poor [illegible] and has little effect against bacterial spores. When [illegible], a contact time increase contact time. Alcohol acts as a [illegible]. [illegible] any residual upon evaporation, but does have a [illegible].

Quaternary ammonium compounds (example: Zephiran) are not effective against spores, tubercle bacilli, and [illegible] and should not be used in the dental office as disinfectants (1).

STERILIZATION OR DISINFECTION OF [illegible]

Instruments and equipment must be completely clean before dental items are sterilized or disinfected. Coagulated protein or other debris can inactivate disinfecting or sterilizing solutions and act as a coating to protect microorganisms from these solutions. The design, size, and construction of some dental equipment complicate disinfection and sterilization. Ideally, all instruments and equipment used for patient care should be sterilized. Since this isn't possible, the level of microorganism inactivation/destruction necessary must be considered in terms of practicality for various material and their planned use.

Water Lines

Mechanical retraction of fluids into the high-speed water line poses a great threat for cross-contamination between patients (10).

Water Retraction--Any water retracted should be contained within the handpiece. For an easy test, operate the high-speed handpiece, with the operating tip in a small cup of water with one drop of disclosing solution. Stop the handpiece and detach it at the coupling. With the coupling over a piece of white paper activate the rheostat. If red dye is discharged, water retraction is excessive. Retraction can be stopped by placing an antiretraction valve in the water line to the high-speed handpiece.

Latent Bacterial Growth--Latent growth of aquatic bacteria in all dental-unit water lines compounds the problem of disinfection. To markedly reduce contamination, at the beginning of the day flush water for 2 minutes through the drinking water dispenser, air/water syringe, and high-speed handpiece (hold bur with gauze or cotton). After a 24-hour or more unit shutdown, flush water for 6 minutes (18).

Aseptic-Water Delivery Systems--Sterile water or saline is often needed to irrigate surgical sites and root canals or to treat certain very high risk patients (example: immunosuppressant drug patients, cardiac pacemaker patients). Sterile-water tanks that use either premeasured bags or bulk fluid can be mounted easily on dental units or in the treatment area.

Nitrous Oxide Inhalation Equipment

Use savaging masks that are heat sterilizable (example: Brown Savaging Mask). Wipe mask after each patient use with 1:20 diluted iodine disinfectant. After the end of the day, wash mask with soap and water or heat sterilize. Place mask through chemical vapor or steam autoclave sterilizer cycle at least weekly.

Fixed and Semifixed Dental Items in DTR

Critical Fixed Equipment--Disinfect (as depicted in Fig. 1) before the first patient of the day and after each patient is dismissed.

Critical Semifixed Equipment--

(1) Dental Handpieces. Handpieces are a weak link in the chain of effective sterilization or disinfection in the dental office.

(a) Heat sterilize handpieces designed to withstand heat. Lubricate a handpiece after thermal sterilization, never operate high-speed handpieces without a bur in the chuck. For heat-labile handpieces, use ethylene oxide sterilization when available. Replace or convert nonsterilizable handpieces as soon as possible. [The Table of Allowances, TA 891, allows 3 high-speed and 3 low-speed handpieces per DTR.]

(b) For routine use, disinfect heat-labile handpieces by scrubbing them at the sink with a 1:20 iodophor solution diluted with alcohol; then rinse with water. If a handpiece does not reach the sink, wipe it thoroughly,

twice, using gauze sponges saturated in iodophor solution diluted with alcohol or wipe thoroughly once and then wrap in a second iodophor-saturated sponge until the handpiece is ready for use.

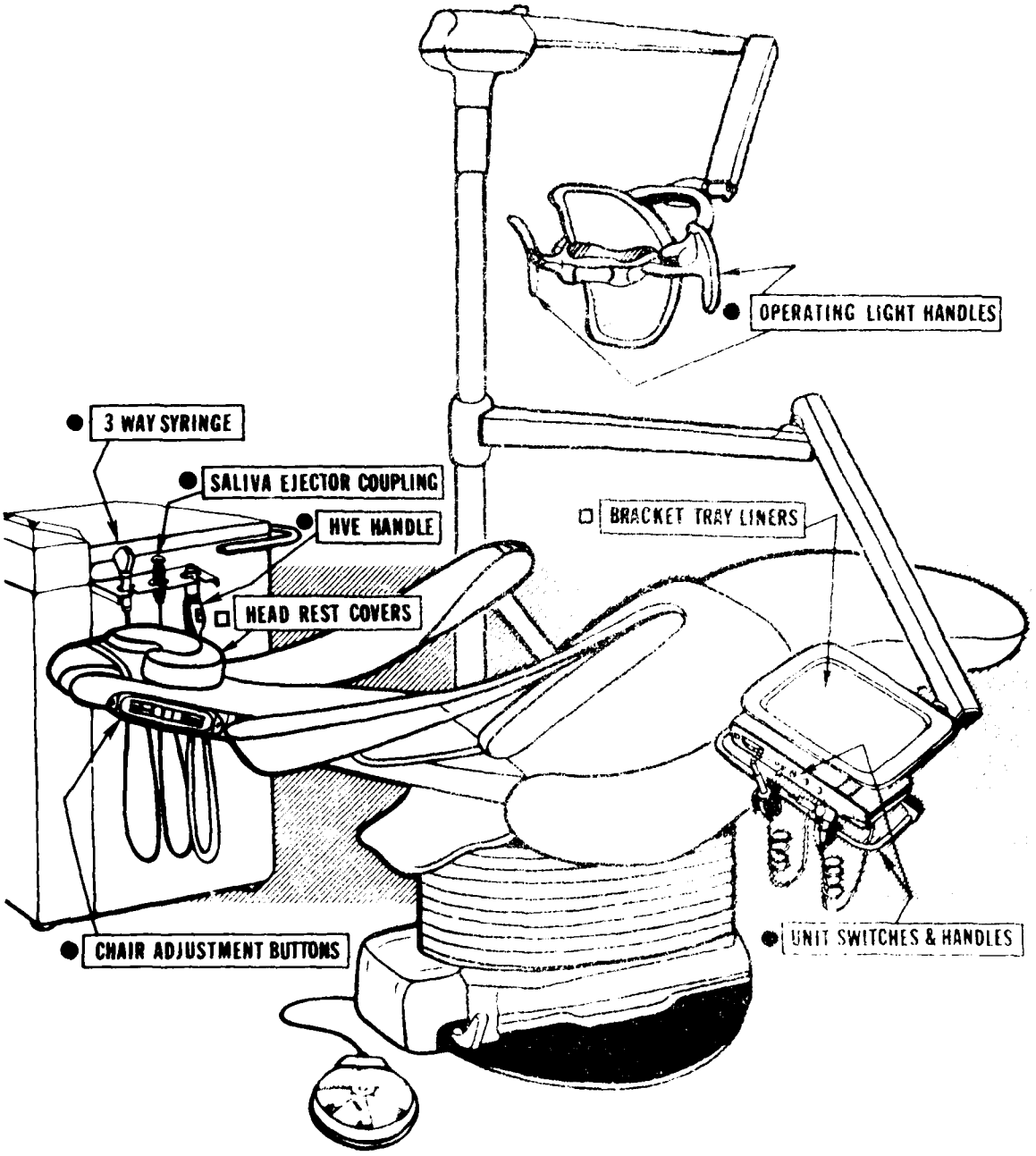


Figure 1. DTR equipment that requires disinfection.

(2) Three-way Syringe Tips and Aspirator Tips. Saliva and debris can be retracted into the 3-way syringe tips and possibly contaminate other patients unless the tips are removed and sterilized after each patient. If the syringe tips cannot be removed for sterilization, disinfect them by the method stated for heat-labile handpieces. After each patient, sterilize aspirator tips. Some reusable plastic aspirator tips cannot be heat sterilized; immerse these in an acceptable sterilization/disinfectant solution. [Each DTR should have at least three autoclavable 3-way syringe tips and three aspirator tips.]

Noncritical Fixed and Semifixed Equipment--At least weekly, preferably daily, use disinfectant solution to wipe off dental unit and chair areas not designated in Figure 1 to be cleaned between patients.

Miscellaneous Items and Materials in DTR

Stainless-Steel Instruments--Autoclave or chemiclave.

Carbon-Steel Instruments--Sterilize using chemical vapor under pressure. Dry heat is an acceptable alternative.

Endodontic Instruments--Sterilize using dry heat. Chemical vapor under pressure is an acceptable alternative. When small endodontic instruments must be resterilized at chairside, use the heat-transfer method.

Instruments Containing Heat-labile Plastics--*Sterilize* using long-term undiluted alkaline glutaraldehyde soak or ethylene oxide. *Disinfect* using a 10-minute glutaraldehyde soak, a 1-minute sodium hypochlorite soak (unless instruments contain metal), or an iodophor wipe.

Anesthetic Cartridges (Disinfection)--

(1) Store the cartridges in a dry state. Just before the syringe is loaded, the diaphragm of the cartridge may be wiped with a sterile 2x2-inch gauze pad moistened with 70% isopropyl alcohol.

(2) If storage in alcohol is desired, place cartridge in an alcohol solution with dye added (example: 3-5 drops methylene blue) but do not immerse for longer than 12 hours. Long-term immersion can change properties of the anesthetic solution. Before use, verify that no color change has occurred in anesthetic solution.

Anesthetic Cartridges (Sterilization)--Anesthetic carpules can be sterilized with less than 5% loss of epinephrine potency (17). Place up to seven cartridges in a paper envelope. Fold envelope snug around cartridges on all sides and secure with autoclave indicator tape. Cycle through autoclave or chemical-vapor sterilizer without a prevacuum cycle. At the end of the cycle, allow sterilizer to return to normal pressure. Forcing the sterilizer door open early may dislodge the rubber stoppers. Allow solution to return to room temperature before opening envelope.

Cloth, Cotton, and Gauze Materials--Store presterilized bulk packages of gauze pads, cotton rolls, and pellets in a covered container after initial seal is broken. If local sterilization is desirable, autoclave the material.

Rubber Products--Sterilize by ethylene oxide. Autoclave hard rubber or nylon products, such as bite blocks.

Glassware--Sterilize by chemical vapor under pressure or dry heat. Autoclaving is an acceptable alternative if the autoclave has a drying cycle or is vented rapidly and the door opened about 1/2 inch for 10-15 minutes at the end of the cycle.

Powders--Sterilize using the dry heat method.

Burs--Place on an autoclavable bur block or magnetic strip before placing into a chemical-vapor or dry-heat sterilizer. [Only burs to be used on the patient in the chair should be placed on the bracket table, or in view of the patient.]

Radiographic Positioning Devices--Most of the devices are nonautoclavable, so chemical disinfection is necessary. Until fully autoclavable devices are available, use an undiluted 2% glutaraldehyde solution which can both disinfect and sterilize. The following procedures are recommended:

(1) For *disinfection*, immerse the device in glutaraldehyde solution for a minimum of 30 minutes between patients (see "Disinfection Methods").

(2) For *sterilization*, immerse the device in undiluted 2% glutaraldehyde for a minimum of 6 3/4 to 10 hours each evening to destroy resistant pathologic spores.

(3) Before use in the oral cavity, rinse the immersed positioning device thoroughly with water.

Nonsurgical Instruments and Trays in Mobile Cabinets--Disinfect instrument trays every other week with 4x4 gauze swabs saturated with iodophor solution. Sterilize unwrapped instruments in drawers at least monthly.

HANDWASHING AND GLOVING

We cannot ascertain the resistance level of each patient to each infectious agent, so a thorough handwashing practice by all attendants is necessary to reduce infectious agents below threshold levels. Both dental officers and assistants should be familiar with the proper manner of gloving.

Surgical Procedures

Hand scrub--

(1) Remove jewelry from hands and wrists.

(2) Clean under the fingernails with a clean plastic or orange-wood stick.

(3) Scrub hands for 4-5 minutes with either a sterile brush or sponge, using an iodophor or chlorhexidine gluconate antiseptic to a point near the elbows. (For subsequent glovings during the same day, 1-minute scrubbing of

hands is sufficient because of the residual action of the antiseptics.) Rinse hands under running water, starting with the fingers and ending with the water running off at the elbows. After rinsing, keep the hands above the level of the elbows.

(4) Dry hands with a sterile towel before gloving in an aseptic manner.

Gloving--Dental officers and assistants must wear presterilized gloves for any surgical procedures. (They should also be worn for routine treatments when cross-infection is likely (12).) When gloves are worn for extended periods, hand antisepsis becomes extremely important. Microorganisms, both resident and transient, multiply rapidly under gloves. Corn starch is the only FDA-approved powder for use in gloves. If a patient is hypersensitive to corn starch, thoroughly wipe the powder off the gloves with one or two damp gauze pads or rinse off with sterile water after gloving.

Routine Nonsurgical Procedures

Handwash--

(1) At the beginning of the work day

(a) remove all rings,

(b) wet hands with cool to lukewarm water,

(c) dispense pool of chlorhexidine gluconate or iodophor scrub solution (about the size of a quarter) into cupped hand,

(d) wash vigorously using a sterilized brush around nails and cuticles (about 15 seconds),

(e) rinse (about 10 seconds),

(f) dispense pool of detergent (about the size of a quarter) into cupped hand,

(g) wash (about 7 seconds),

(h) rinse (about 7 seconds), and

(i) dry hands with disposable towel.

(2) Between patients, before lunch, before leaving for the day, and after break in routine, follow handwash steps f to i.

Wearing of Gloves--Gloves should be worn when the following nonsurgical conditions exist:

(1) A patient has lesions adjacent to mouth or lips or on intraoral mucosa.

(2) The operator's hands have small wounds or cuts. (A small lesion on a finger may be covered with a finger cot instead of gloves.)

(3) When cleaning and scaling procedures produce noticeable bleeding that will reach the operator's hands.

DENTAL LABORATORY ASEPSIS

Prostheses and/or impression materials can transmit pathogenic microorganisms to the dental laboratory. In the DTR, dental instruments are sterilized after each use, but this is neither conventional nor practical in the dental laboratory. Procedures must be established to reduce microorganism transfer, by breaking the chain of infection at critical transfer points in the fabrication, repair, and handling of prostheses.

Handling Prostheses

Before commencing work on a prosthesis brought into the laboratory, thoroughly clean the device with a surgical scrub brush, running water, and detergent (iodophor or chlorhexidine gluconate), or if device is nonmetal, immerse it in 1:10 diluted sodium hypochlorite (household bleach) for 2-3 minutes. If possible, in the dental treatment room scrub prostheses that are to be embedded in an impression, before making the impression. Rinse impressions under gently running water to mechanically remove debris. Never scrub or allow dental gypsum products (e.g., casts and jaw relation records) to soak in anything other than saturated slurry water.

Grinding and Polishing

Use a liquid disinfectant (e.g., 5 parts sodium hypochlorite to 100 parts distilled water) as the mixing medium in pumice. Adding 3 parts green soap in the disinfectant solution will keep pumice suspended (20). Use two pumice pans--one for new prostheses, which will be disinfected weekly, and one for used prostheses, which will be disinfected daily. Separate laboratory attachments (e.g., burs, rag wheels) used on prostheses that have been in the mouth from like items used on prostheses that have not been in the mouth. Sterilize laboratory attachments used on new prostheses at least weekly, and those used on prostheses that have been in the mouth, at least daily. Sterilize wheels by washing them and placing them individually in 4-inch tubing. Seal the tubing and sterilize the wheels in the autoclave. Since bristles on bristle brushes become brittle and break off after heat sterilization, periodically rinse these brushes well, place them in undiluted glutaraldehyde for manufacturer's recommended sterilization time, and rerinse before use. At the end of the day scrub the rotary burs used for adjusting and put them in a glass specimen bottle containing undiluted glutaraldehyde. Place the bottle in the ultrasonic cleaner for 10 minutes and allow the rotary instruments to remain in the bottle overnight. Thoroughly rinse the sterilized burs in the morning before using them. After polishing new or repaired prostheses, clean as described in the preceding paragraph, and rinse before delivering to the doctor for insertion.

Grinders and Lathes--Use an evacuation system when grinding on metals. Ask Bioenvironmental Engineering (BEE) to monitor all evacuation systems on a yearly basis.

Dust Respirators--If evacuation is deemed less than adequate by BEE, use a highly efficient and lightweight dust respirator (example: 3M brand toxic dust respirator #9900 or dust respirator #8710). Dust respirators are 99.99% effective against filtration of 0.6-1.0-μm particles.

Safety Glasses--To eliminate trauma or microbial contamination of the eyes, always use safety glasses when operating a lathe. Use the eye shield when provided on the lathe.

Miscellaneous Equipment and Materials

Compound Heater Liners and Inserts--Empty and disinfect liners and liner inserts after each use. Store them empty.

Impression Trays--Scrub trays in soapy water and place in 4-inch plastic or nylon tubing. Use autoclave or chemiclave for sterilizing trays (do not use dry heat). If the trays are to be hung in a cabinet, place another heat seal about 1 inch from the first sealing so that the bags can be hung without compromising sterility.

Ultrasonic Cleaners--Cover ultrasonic units with lids at all times. Change solutions at least weekly, daily if needed. (See "Preparing Items for Sterilization.")

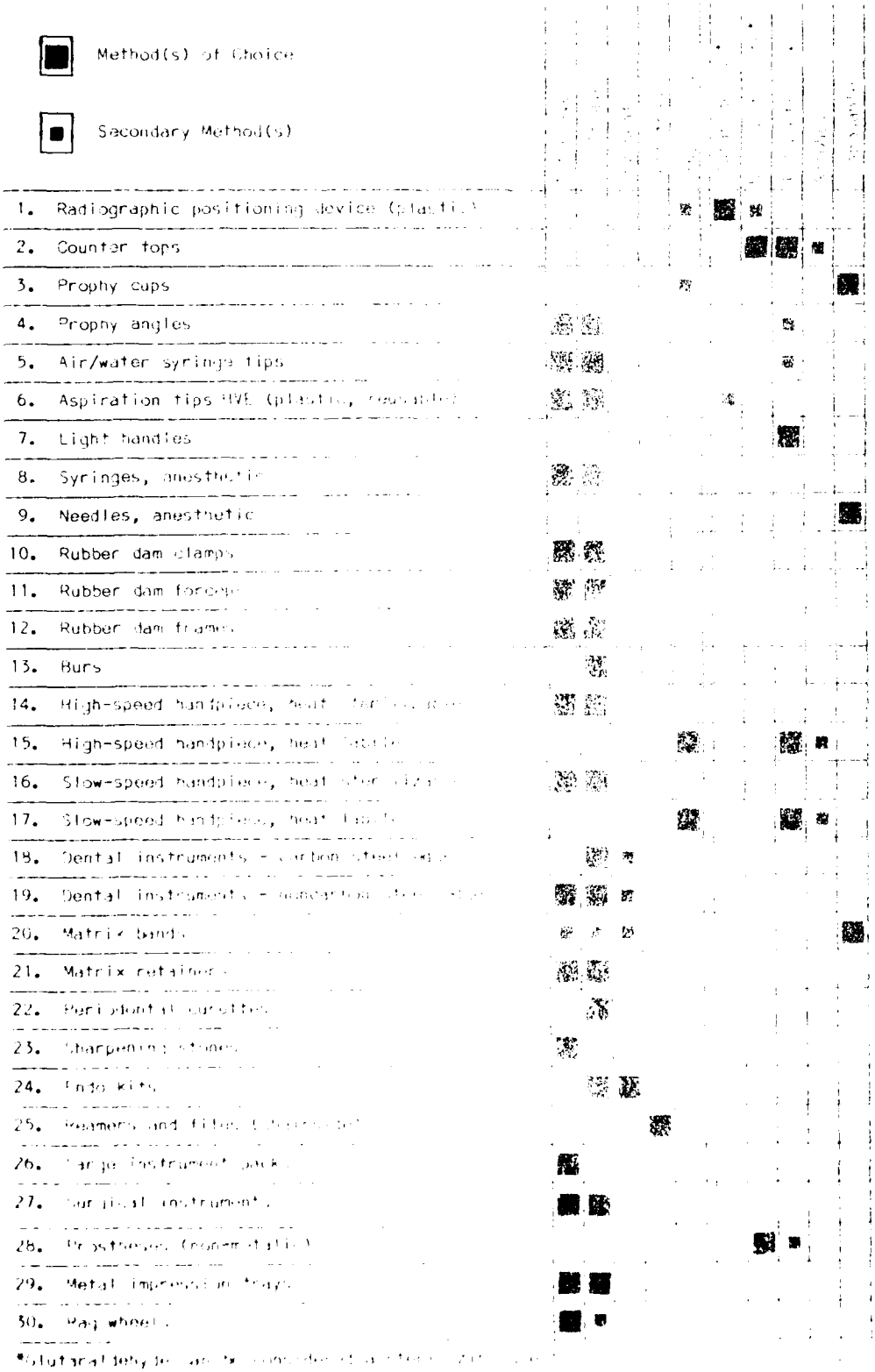
Slurry Water--Make slurry water from fresh set stone that has never been poured against an impression.

Shell and Sand Blasters-- Change filters on a routine basis. Dry all items to be blasted.

DENTAL ITEM STERILIZATION

■ Method(s) of Choice

▪ Secondary Method(s)



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